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THE REDISTRIBUTIVE EFFECTS OF LOTTERIES IN WESTERN CANADA

By

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Abstract

The purpose of this paper is to determine the income-redistributive effect of lottery programs in western Canada. This requires estimation of both the tax and the expenditure incidence of lottery profits. Previous research has been limited to measuring the tax incidence. The lotteries examined are found to be regressive in collecting public revenue, but considerably less regressive than the U.S. lotteries examined in the literature. In addition, the distribution of benefits resulting from the expenditure of lottery profits mildly favours upper-income groups. Thus, lottery programs in western Canada are a regressive form of income redistribution.

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1. Introduction

Public lotteries have become an increasingly important source of government revenue in Canada and the United States in the past decade. In Canada, the total profits of provincial lotteries increased from $37.4 million in 1972 when only one province (Quebec) operated a lottery to $349.7 million in 1981 by which time all 10 provinces had been involved in the operation of lotteries for five years. This represents an average annual growth rate of 26.6% in lottery profits which is considerably faster than the 9.0% average annual growth rate of the Consumer Price Index over the same period. Moreover, in 1972, lottery profits were 0.26% of all provincial government revenues generated from own sources but by 1981 this figure had risen to 0.62%.[1]

Lottery programs in Canada can be viewed as an excise tax on lottery games and an equal-yield subsidy on specific consumer goods and services in the economy. The lottery revenues received by the provincial governments are, on average, 141% of the cost of providing the lottery games (including the cost of prizes). This yields an implicit excise tax rate on lottery games of 41%.[2] The profits from lottery programs are redistributed in the economy by subsidizing recreational and cultural consumer goods and services.

The purpose of this paper is to determine the income-redistributive effect of public lotteries in Canada. To address this issue, one must examine both the tax and the expenditure incidence of lottery profits. Previous research has been limited to measuring only the tax incidence of public lottery profits and only in the United States. Spiro (1974), Brinner and Clotfelter

(1975), Suits (1977) and Clotfelter (1979) all find overwhelming evidence of tax regressivity. For example, Brinner and Clotfelter (1975) estimate that a family in the lowest income group in Connecticut spends .55% of its annual income on state-operated lotteries while a family in the highest income group spends only .06% annually. While these studies have made very important findings, they do not provide a complete analysis of the issue of income redistribution since the expenditure incidence of lottery profits is not investigated. This is a particularly critical omission since for all Canadian lotteries and many U.S. lotteries, profits are earmarked for use in particular programs in the local economy rather than being added to general tax revenues. In these cases, lotteries result in a direct transfer of income from consumers of lotteries to consumers of those programs funded by lottery profits.

The paper is organized as follows. In Section 2, new evidence is provided on the tax incidence of lottery profits. Because evidence of this type has not been presented before using Canadian data it is interesting to make comparisons with previous results based on U.S. data. The expenditure incidence of lottery profits in Canada is estimated in Section 3. Then, the redistributive effect of lotteries is determined by calculating the transfers of income among income groups that occur as a result of lotteries. Conclusions are drawn in Section 4.

2. Who Buys Lottery Tickets?

The data used to determine the tax incidence of lottery profits were obtained as part of the annual survey of Edmonton

residents conducted by the Population Research Laboratory at the University of Alberta. A total of 545 addresses were randomly drawn from a complete list of city addresses from the most recent enumeration (1983).[3] Interviewers were sent to these addresses to ask a variety of questions, a subset of which dealt with the annual income level and the average monthly purchases of lottery tickets by the individual being interviewed and the individual's household.[4] With a response rate of 77.3%, the total sample size was 421. Of these, 34 "household" and 24 "individual" observations were spoiled by the respondent's answering "do not know" to either the question of income level or number of lottery tickets purchased.

Approximately 59.2% of all households and 54.4% of all individuals surveyed purchase lottery tickets in an average month. The largest share of gross income spent on lotteries was 13.9% by an individual and 12.5% by a household.

To investigate the question of regressivity, we begin by organizing all data for individuals and households into 9 income cells. Tables 1a and 1b contain summary statistics for these data. Of particular relevance are the entries in column 5 of these tables which show the average income shares spent on lottery tickets for (a) households and (b) individuals within each of the nine income cells. The surprising finding is that an obvious case for regressivity does not appear since the average income share spent on lotteries is not a monotonically decreasing function of income. This is quite unlike the evidence found a decade ago in the United States. In order to conduct a formal

Table 1a

Summary Statistics for Households

(1) Income Group ($'000)	(2) No. of Obser-vations	(3) Average Income ($'000)	(4) % Reporting Lottery Purchase	(5) Average Share Spent on Lottery Tickets by All in Group (%)	(6) Average Share Spent on Lottery Tickets by Ticket Buyers (%)
1. 0-10	55	5.98	32.7	0.53	1.61
2. 10-14	31	12.22	54.8	0.79	1.44
3. 14-20	37	17.0	59.4	0.60	1.01
4. 20-26	59	22.93	64.4	0.77	1.20
5. 26-34	43	29.79	79.1	0.44	0.56
6. 34-40	32	36.87	75.0	0.47	0.62
7. 40-50	55	44.95	76.4	0.38	0.51
8. 50-60	32	54.22	68.7	0.24	0.36
9. 60+	43	71.05	27.9	0.46	0.66

Table 1b

Summary Statistics for Individuals

(1) Income Group ($'000)	(2) No. of Obser-vations	(3) Average Income ($'000)	(4) % Reporting Lottery Purchase	(5) Average Share Spent on Lottery Tickets by All in Group (%)	(6) Average Share Spent on Lottery Tickets by Ticket Buyers (%)
1. 0-10	138	4.68	39.1	0.91	2.33
2. 10-14	39	12.18	64.1	1.28	1.99
3. 14-20	60	17.03	55.0	0.34	0.61
4. 20-26	56	22.61	64.3	0.60	0.94
5. 26-34	41	30.12	75.6	0.36	0.48
6. 34-40	29	37.00	65.5	0.60	0.95
7. 40-50	21	44.17	57.1	0.13	0.22
8. 50-60	5	54.50	80.0	0.16	0.20
9. 60+	8	71.56	25.0	0.03	0.11

test of the hypothesis that (a) households' and (b) individuals' share of income spent on lotteries is a decreasing function of income level, we performed a regression of income share, s_i, i = 1,2,...,N, where N = number of respondents, against income level. However, because s_i has a limiting value of zero and because many observations are clustered at this point, the following limited dependent variable model was estimated:

$$s_i = \begin{cases} Y_i \beta + e_i & \text{if } Y_i\beta + e_i \geq 0 \\ 0 & \text{otherwise} \end{cases} \qquad (1)$$

Here, Y_i is a row vector with the first element being the number one and the second element being the income level of the ith respondent and s_i is the share of income spent on lotteries by the ith respondent. The maximum likelihood estimation technique, TOBIT, accounts for the influence of income level on the binary decision of whether or not to buy lottery tickets, as well as its influence on the decision regarding the amount to purchase once the choice to buy has been made.[5] Separate regressions for households and individuals were performed. This analysis resulted in the following estimates of β_0, the constant term and β_1, the slope coefficient.

Table 2

	β_0	β_1	N
Households	-0.02 (-0.13)	0.23×10^{-5} (0.5)	387
Individuals	-0.07 (-0.3)	-0.9×10^{-5} (-1.0)	397

The t-statistics in parentheses indicate that none of the

estimated parameters is significantly different from zero. These results indicate that income level alone does not explain the expenditure behaviour on lotteries by individuals and households. An expanded version of the model was estimated therefore, in which the following additional explanatory variables were included: sex, age, employment status in the previous year, and level of education attained. Interestingly, only the education variable had a significant (negative) influence on the dependent variable.

Insight into the lack of explanatory power of income level is provided by the results of two experiments. First, a binary variable, P_i, which has the value zero if s_i is zero and the value one if s_i is positive, was assigned to each observation. A PROBIT analysis of P_i revealed that the probability of buying lottery tickets is significantly and positively influenced by income level. This tends to make s_i an <u>increasing</u> function of income. Next, for only those observations where $s_i>0$, an OLS regression of s_i on income was performed and revealed a significant, negative relationship. This tends to make s_i a <u>decreasing</u> function of income. Thus, higher-income individuals and households are more likely to purchase lottery tickets but higher-income purchasers spend a smaller share of their income on lotteries than lower-income purchasers. These two effects apparently cancel out in the TOBIT analysis.

Our results appear to contradict the findings of previous research. However, none of the previous work in this area has included a regression analysis based on disaggregate data of this type. Rather, previous regression analysis has been based on

data which has been averaged in some way such as in Tables 1a and 1b where nearly 400 observations on individual expenditure behaviour have been reduced to 9 observations on average expenditure behaviour. The disadvantage of doing this is that a great deal of information is lost. The advantage is that the averaging process eliminates "noise" in the data that cannot be explained by the model in (1). For this reason, one might prefer to use the averaged data to test the hypothesis of regressivity. If we do regress the average income shares in Table 1 against the average income in each cell, we obtain significantly different results regarding regressivity as shown in Table 3.[6]

Table 3

	b_0	b_1	N_j	R^2
Households	0.684 (7.3)	-0.492×10^{-5} (-2.0)	9	0.36
Individuals	0.980 (7.1)	-0.164×10^{-4} (-2.9)	9	0.54

These results indicate a statistically significant downward trend in the average income share spent on lottery tickets as income rises. This result, which holds for both households and individuals is evidence in support of the hypothesis that lottery taxation is regressive.

In order to compare the regressivity of the lotteries studied in this paper to the regressivity of two American lotteries examined by Clotfelter (1979), two additional regressions were performed which have the same structure as those estimated in his study of household expenditures on lotteries. Namely, if $\bar{x}_i$ is the average expenditure in the ith income class for

households then

$$\ln\bar{x}_i = A + B\ln\bar{Y}_i + u_i \qquad i = 1,2,\ldots,9 \qquad (2)$$

where $\bar{Y}_i$ is the average income in the ith income class. In equation (2), the income elasticity, B, is constrained to be constant. In the model estimated in Table 2, income elasticity is allowed to vary with income and on these grounds, is the preferred functional form. However, for the sake of comparison, equation (2) was estimated with the following result:

	B	Standard error
Households	.720	0.141

On the basis of this result, one concludes that the income elasticity for households is significantly less than unity, again indicating regressivity. In addition, this estimate, combined with the low standard error, indicates that the income elasticity for household expenditure on lotteries in our sample is significantly larger than for the two American lotteries examined by Clotfelter (1979) where estimates ranged from .062 to -1.112. Thus, we also conclude that the Canadian lotteries examined in this study are <u>less</u> regressive than the two U.S. lotteries examined by Clotfelter.

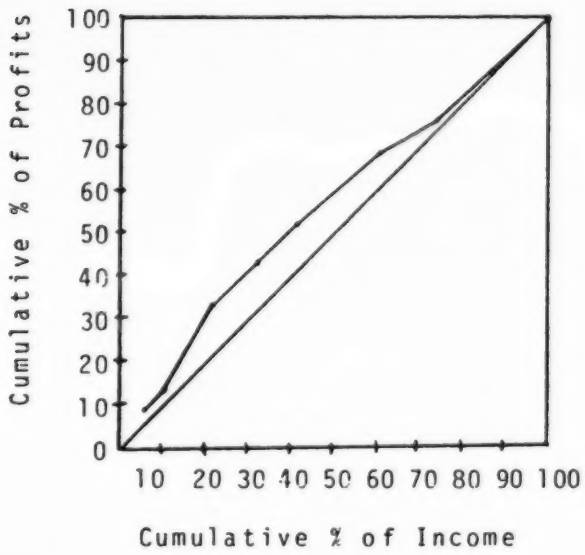
Another way of measuring the regressivity of lotteries is to construct a Lorenz-type curve.[7] This is done by first ranking all observations on lottery expenditures in increasing order of income and then by calculating the accumulated percentage of the total income in the sample at each observation and the corresponding accumulated percentage of the total expenditure on

lotteries. This curve is plotted in Figure 1.

The fact that the Lorenz-line in Figure 1 lies above the diagonal is additional evidence that the tax incidence of lottery

Figure 1

Tax Incidence of Lottery Profits



profits is regressive. It shows, for example, that the households receiving the lower 50% of the total income in the sample contributed more than 50% of the lottery profits. Moreover, it is possible to use the information in this diagram to compute the Suits(1977) index of regressivity.[8] Analogous to the Gini index of income inequality, the Suits index lies in the range [-1, +1], with -1 and +1 indicating the extremes of regressivity and progressivity, respectively, and 0 indicating neutrality. For households in our sample, the index value is -0.10. Compared to

the index values of -0.31 of Suits(1977) and -0.24 of Clotfelter (1979), the evidence again indicates that the Canadian lotteries examined in this study are less regressive in collecting revenues than their American counterparts.[9]

3. Who Benefits from Lottery Profits?

In Canada, lottery profits are earmarked for certain recreational and cultural activities and programs. The profits in Alberta are administered by the Alberta division of the Western Canada Lottery Foundation. This corporation's annual reports indicate that 60% of lottery profits are allocated to the Edmonton Exhibition Association Ltd. and the Calgary Exhibition and Stampede Ltd. These two non-profit organizations are primarily engaged in the provision of entertainment, recreation and sporting activities for the citizens of Alberta. Another 12% of profits is given to the Recreation, Parks and Wildlife Foundation. The remaining recipients receive shares ranging from 5% to 0.5% and are all non-profit organizations which provide cultural or recreational services.[10]

In order to estimate the expenditure incidence of lottery profits, it is assumed that individuals benefit from lottery profits by consuming subsidized goods and services at slightly reduced prices. In addition, it is assumed that the size of benefits received is proportional to the expenditure on the subsidized goods and services.[11] Thus, consumer expenditure data can be used to estimate the expenditure incidence of lottery profits.

Expenditure data on the class of commodities that is

subsidized by lottery profits are available in the 1978 and 1983 surveys by Statistics Canada of families living in 8 major Canadian cities. The surveys contain information regarding average family expenditure, by income group, in each of 13 broad categories of commodities. The only one of these categories that contains the types of commodities subsidized with lottery profits is the one called "Recreation". However, some of the items in this category, such as "Home Entertainment" expenditures are clearly not relevant. Thus, a subset of the "Recreation" category which contains only the types of items that are subsidized was selected. Assuming that expenditure patterns across income classes on this selected group of commodities is the same as that on the specific commodities subsidized with lottery profits, this pattern can be used to estimate the expenditure incidence of lottery profits.

Only the 1978 Statistics Canada survey publishes detailed expenditure information on the list of items within the recreation category. Therefore, only this survey can be used to calculate the percentage of gross annual income spent on the selected recreational items by the average family in each of the 9 income groups.[12] In Table 4, one sees that expenditures on these items range from a high of 1.98% of income for the third highest income group to a low of 1.10% of income for the second lowest group. A Generalized Least Squares regression of these average expenditure shares on the average incomes produces positive slope and intercept coefficients, both of which are significantly different from zero. Thus, the income elasticity of demand for these

Table 4

Percentage of Annual Income Spent by Families on Selected Recreation Items

Income	Average Percentage Expenditure
$0-10,069	1.36
10,070-13,429	1.10
10,430-20,149	1.30
20,150-26,869	1.35
26,870-33,589	1.52
33,590-41,929	1.96
41,980-50,379	1.98
50,380-58,769	1.80
58,770 +	1.73

commodities exceeds unity.

The fact that the average expenditure share on commodities subsidized by lotteries rises with income suggests that the distribution of lottery benefits is biased in favour of higher income groups. This hypothesis is investigated further by using the data to construct a Lorenz-type diagram which compares the accumulated percentage of total expenditure with the corresponding accumulated percentage of total income.[13] Under our assumptions, an income group's share of total expenditure on this subset of commodities is equal to the group's share of the total benefits of lottery profits.

Figure 2 shows the Lorenz line lying just below the diagonal, implying that the expenditure incidence of lottery profits is slightly progressive in that it provides a larger proportionate income subsidy to higher income families. For example, the lower 50% of incomes receives approximately 48% of total benefits that result from the spending of lottery profits.

Assuming that the expenditure patterns of households in

our sample from Edmonton are similar to those in the Statistics Canada data, then the results summarized in Figures 1 and 2 can be combined to show that lottery programs in western Canada re-distribute income from lower to higher income groups. For example, households with annual incomes less than $20,000 have nearly 11% of the total income in the sample, provide nearly 15% of the total lottery profits in the sample, but receive only about 6% of the total benefits. In contrast, households with annual incomes over $42,000 have 39% of the total income in the sample, provide about 32% of the total lottery profits, and receive about 38% of total benefits.

Figure 2

Benefits Incidence of Lottery Profits

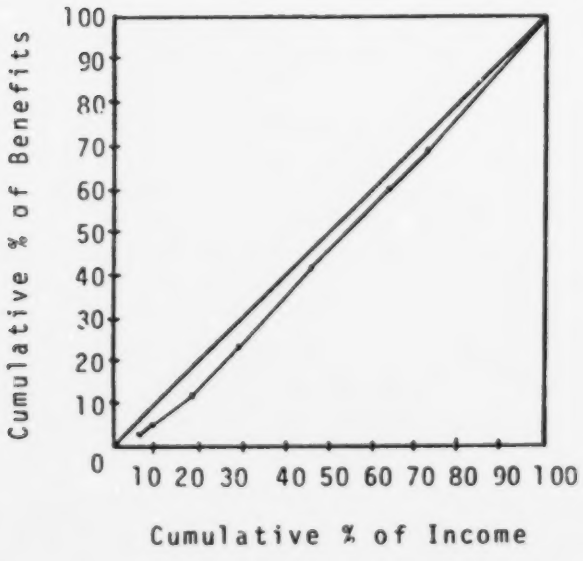
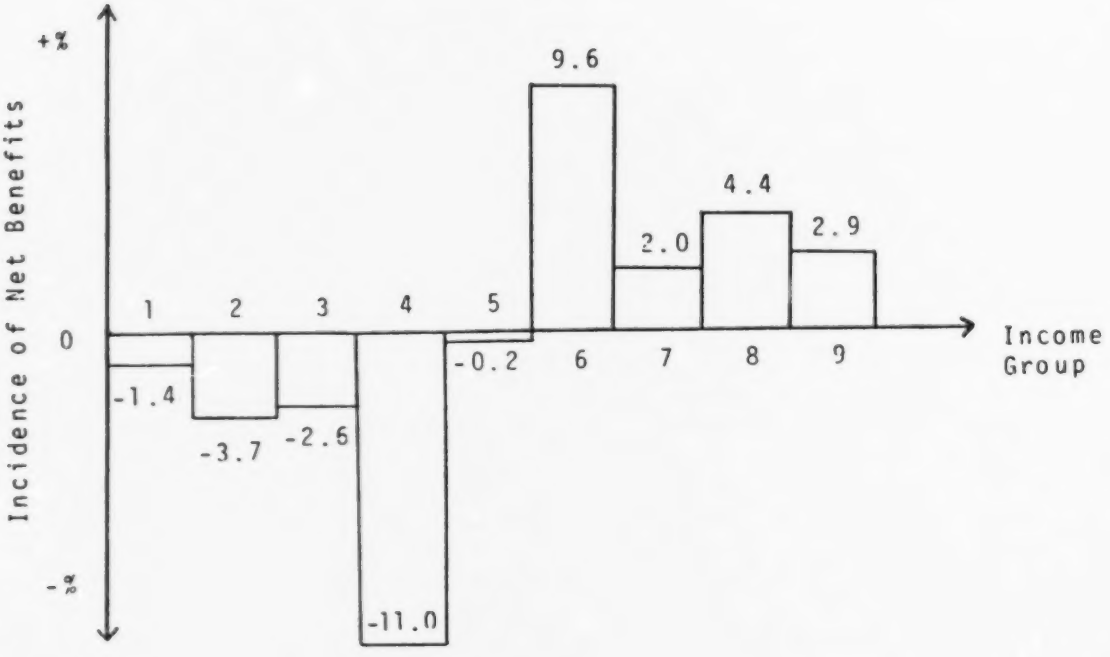


Figure 3



A clearer indication of the relative net benefits received by income classes is provided in Figure 3. Here, the difference between the percentage of total benefits received and the percentage of total lottery profits paid by each of the 9 income groups is plotted. In this diagram, one sees very clearly that the direction of income transfers is from the low groups to the high groups. In particular, income is transferred from the bottom four income groups, families earning less than approximately $30,000, to families in the top four income groups, with families in the middle group being relatively unaffected. Moreover, the greatest amount of income redistribution appears to be from the

low middle income area (income group 4) to the middle income area (income group 6).

4. Conclusion

The objective of this paper has been to determine the income-redistributive effects of government-owned lotteries by estimating both the tax and the expenditure incidence of lotteries in western Canada. On the basis of the results, it is concluded that the lottery program in western Canada redistributes income from low to high income groups. This occurs first because the tax incidence is regressive and second, because the expenditure incidence is progressive. The results indicate that on average, households earning above $30,000 in 1984 received an income transfer through the lottery program from families earning below $30,000.

Although it was not possible to compare the redistributive effects of Canadian and American lotteries because there are no studies in which the expenditure incidence of the latter have been estimated, it was possible to compare the tax incidence of particular Canadian and American lotteries. This comparison showed that the American lotteries studied by Suits (1977) and Clotfelter (1979) are considerably more regressive than the Canadian lotteries examined in this study. While it is beyond the scope of this paper, future research on a theory of lottery purchasing behaviour by households might provide an explanation for this difference.

Footnotes

1. See Johnson (1976) for an international comparison of lotteries and a general analysis of the efficiency and equity effects of lotteries.
2. While this is a high rate of excise taxation, it is not as high as any of the eight U.S. lotteries analyzed by Brinner and Clotfelter(1975). The excise tax rates in their study ranged from a low of 61% in New Hampshire to a high of 92% in New York.
3. Nursing homes, military and temporary residences were excluded from the population sampled.
4. The "individual" is defined as the person responding to the questions. The "household" is defined as the sum of all persons living at the selected address. In addition, attempts were made by the interviewers to obtain an equal number of male and female respondents. These efforts resulted in a final sex breakdown of 47.5% male and 52.5% female. See Kinzel (1985) for more details.
5. Tobin (1958) developed this model, a hybrid of PROBIT and OLS.
6. Heteroskedasticity is introduced by using grouped data. Therefore, the estimates in Table 3 were obtained using an appropriate Generalized Least Squares procedure. See Johnson (1984, 293-296).
7. Suits (1977) uses this method to investigate the regressivity of lotteries.
8. Suits (1977) defines the index as S=1-L/K where L is the area under the Lorenz curve and K is the area under the diagonal.

9. To provide a better indication of the meaning of these results, I have calculated the Suits index for all Canadian taxes combined and selective Canadian excise taxes alone (tobacco, alcohol, fuel oil and several minor commodities) from data presented in Gillespie (1976). The index values are -0.05 and -0.17, respectively indicating that the Canadian lotteries are more regressive than average, but not the most regressive tax. Note that this ranking of regressiveness by the Suits index would be unaffected by using a different index since the Lorenz lines do not cross.
10. Prize winners are also beneficiaries but it is assumed that the distribution of prizes among income groups is the same as the distribution of expenditures on lottery tickets. As a result, prize-winnings have no impact on the distribution of income among income groups.
11. This will be a good approximation to the actual income-increase experienced by consumers of subsidized goods and services as long as the price reduction caused by the subsidy is small. Under this condition, the income increase experienced by consumer is approximately $x_i dp$ where x_i is the consumption of x by consumer i and dp is the absolute value of the price change.
12. The income range of each income group was converted to 1984 dollars from 1978 dollars using the Consumer Price Index.
13. The survey provides the other data required to construct the Lorenz-type curve: the number of families in each income group and average income in each group.

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